REMARKS

Reconsideration and allowance of the subject application are respectfully requested. Claims 1-19 and 21-22 remain pending, claims 8, 13, and 14 having been withdrawn from consideration. Of the claims under consideration, claims 1, 10, 15, and 19 are independent. In this Reply, Applicants have amended claims 1, 10, 11, and 15.

With reference to page 2 of the Office Action, Applicants acknowledge that the rejection of claim 19 under 35 U.S.C. § 102 based on *Rateick, Jr.* (U.S. Patent 5,728,475, hereinafter "the *Rateick* '475 patent") and the rejection under 35 U.S.C. § 103 based on the cited portions of Metal Handbook, 9th Ed. ("Cold Heading") in view of the *Rateick* '475 patent have been withdrawn in favor of new grounds of rejection.

Prior Art Rejections

1. § 103 Rejection: *Beck* - "Cold Heading" - *Rateick, Jr.*

Claims 1-6, 9-12, and 15-18 stand rejected under 35 U.S.C. § 103 as allegedly being unpatentable over *Beck et al.* (DE 196 52 326) in view of cited portions of Metal Handbook, 9th Ed. ("Cold Heading") and further in view of the *Rateick* '475 patent. This rejection is respectfully traversed.

By way of review, independent claim 1 is directed to a method of manufacturing a wear resistant shoe. The method of claim 1, as amended herein, comprises: cold-heading one end portion of a generally cylindrical blank to radially increase and axially diminish the dimensions of the one end portion, and to work harden the one end portion while leaving an opposite end portion dimensionally unchanged and maintaining cold-workability of the opposite end portion; machining the previously cold-headed one end portion to form a cam

engaging portion of said wear resistant shoe; and subsequently cold-working and thereby hardening the opposite end portion.

Thus, as emphasized herein, a feature of the method of manufacturing a wear resistant shoe recited in claim 1 is a step of cold-heading one end portion of a generally cylindrical blank to work harden the one end portion while leaving an opposite end portion dimensionally unchanged and while maintaining cold-workability of the opposite end portion. The opposite end portion is subsequently cold-worked. As described in the specification at pg. 5, line 4 – pg. 6, line. 18, the cold-heading step achieves work hardening of an end portion 38, which comprises the material making up the balance land 28 and the back flange 34 of the wear resistant shoe, to a substantial depth. In addition, the cold-heading step is performed so as to leave the opposite end portion 40, which comprises material making up the skirt 50, in a dimensionally unchanged and unhardened state. Thus, the skirt portion is maintained in a softened condition until work hardening during the subsequent crimping process, thereby allowing the skirt 50 to be crimped without cracking.

The newly-applied primary reference, *Beck*, discloses a technique for manufacturing a shoe for an axial piston machine. As described in the partial English translation of *Beck* provided herewith, and with reference to the figures, *Beck* relies on a forging process to generate an intermediate product 1. In the first embodiment shown in Fig. 1, the forging process results in an intermediate product (i.e., forging) 1 having a recess 10 and an outer contour 2, which is subsequently machined to a finished part contour 3 having a finished recess 10'. The second, third, and fourth embodiments, illustrated in Figs. 2, 3, and 4,

respectively, generate forgings for two parts 4.1, 4.2. In the second embodiment of Fig. 2, the intermediate product 1 includes a pair of recesses 10, whereas the embodiments of Fig. 3 and Fig. 4 do not include a formed recess 10, which is subsequently formed by machining.

In all embodiments of *Beck*, however, it is evident that the forging process used to produce the intermediate product 1 would result in substantial work hardening of the portions used to form the "glide face" 14 and the region for forming the recess (i.e., socket region). In other words, there is no apparent attempt in *Beck* to maintain cold-workability of the socket region. This process is quite distinct from that required by claim 1, which specifies:

> cold-heading of one end portion of a generally cylindrical blank to radially increase and axially diminish the dimensions of the one end portion, and to work harden the one end portion while leaving an opposite end portion dimensionally unchanged and maintaining cold-workability of the opposite end portion.

As stated on page 3 of the Office Action, the Examiner appears to acknowledge differences between the forging process of *Beck* and the manufacturing method required by claim 1, but relies on the teachings of "Cold Heading" to conclude that:

> [I]t would have been obvious to one of ordinary skill in the art to have made the blank "2" of Beck et al by the process of cold heading a generally cylindrical blank because cold heading provides several advantages including leaving almost no waste material and also increased strength due to the cold working (i.e.-work harden).

As discussed in the Reply dated December 9, 2002, "Cold Heading" describes materials, equipment, characteristics, etc., of cold heading as a forging process. Although this reference describes using cold-heading for manufacturing items such as bolts and

rivets, there is no description or suggestion of using cold-heading in the manufacture of a wear resistant shoe, particularly in the manner recited in claim 1.

Furthermore, Applicants submit that "Cold Heading" fails to suggest a modification of the manufacturing technique disclosed by *Beck* that would result in the particular technique for manufacturing a wear resistant shoe recited in claim 1. As mentioned above, the forging process used to make the intermediate product (i.e., forging) 1 of *Beck* would achieve substantial work hardening of the portions used to form the "glide face" 14 and the region for forming the recess (i.e., socket region). Thus, the dies used in the forging embodiments described in *Beck* were not designed to maintain cold-workability of the end portion for the socket region, and any modification of the forging embodiments disclosed by *Beck* to satisfy this feature of the claimed invention would at least require a significantly different die design than those used therein. Particularly considering the lack of concern for maintaining cold-workability of the end portion for the socket region in *Beck*, it cannot be said that such a re-design of the *Beck* forging process is suggested by the art of record.

With specific reference to the "several advantages" the Examiner cites, Applicants note that the forging process of *Beck* would inherently result in work hardening, and there is no objective evidence of record to suggest to one of ordinary skill in the artthat somehow modifying the forging process of *Beck* to include cold- heading would provide an inherent and significant strength improvement of the intermediate product generated by *Beck*, particularly to an extent that would more than offset any drawbacks in die redesign cost/complexity, ease of manufacturing, etc. that may result. Furthermore, there is no objective evidence of record to establish that somehow modifying the manufacturing

process of *Beck* to include cold heading would result in an inherent and significant reduction in waste material, particularly to an extent that would more than offset any drawbacks in die redesign cost/complexity, ease of manufacturing, etc. that may result from such a modification. In short, there is no evidence pointing to the modification of *Beck* relied on by the Examiner to assert obviousness of claim 1. Furthermore, it appears that the asserted modification of *Beck* would fundamentally change the manufacturing process described therein, which supports the conclusion that the asserted modification is not obvious. See e.g., MPEP § 2143.01. The Examiner's reliance on the *Rateick* '475 patent does not make up for this fundamental deficiency of the rejection.

To establish *prima facie* obviousness, all claim limitations must be taught or suggested by the prior art and the asserted modification or combination of prior art must be supported by some teaching, suggestion, or motivation in the applied reference or in knowledge generally available to one skilled in the art. *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988); *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). The prior art must suggest the desirability of the modification in order to establish a *prima facie* case of obviousness. *In re Brouwer*, 77 F.3d 422, 425, 37 USPQ2d 1663, 1666 (Fed. Cir. 1995). It can also be said that the prior art must collectively suggest or point to the claimed invention to support a finding of obviousness. *In re Hedges*, 783 F.2d 1038, 1041, 228 USPQ 685, 687 (Fed. Cir. 1986); *In re Ehrreich*, 590 F.2d 902, 908-09, 200 USPQ 504, 510 (CCPA 1979).

As stated above, Applicants respectfully submit that the reasoning provided to assert a combination of *Beck*, "Cold Heading", and the *Rateick* '475 patent fails to establish *prima facie* obviousness of independent claim 1 or any claim depending therefrom.

Applicants respectfully submit that independent claims 10 and 15, as well as all claims depending therefrom, distinguish over the asserted combination at least based on similar reasoning to that set forth above with regard to claim 1.

In view of the above, Applicants respectfully request reconsideration and withdrawal of the Examiner's rejection under 35 U.S.C. § 103 based on the asserted combination of *Beck*, "Cold Heading", and the *Rateick* '475 patent.

2. <u>§ 103 Rejection: *Beck* - "Cold Heading" - *Rateick, Jr.* - *Harada*</u>

Claim 7 stands rejected under 35 U.S.C. § 103 as allegedly being unpatentable over *Beck* in view of "Cold Heading", the *Rateick* '475 patent, and *Harada* (JP 56-084468).

As stated on page 7 of the Office Action, the Examiner relies on *Harada* as allegedly teaching incremental features of dependent claim 7. Applicants respectfully submit, however, that the Examiner's reliance on *Harada* fails to make up for the deficiencies of the asserted combination of *Beck*, "Cold Heading", and the *Rateick* '475 patent discussed above with reference to claim 1. Therefore, Applicants respectfully submit that the asserted modification of *Beck* in view of "Cold Heading", the *Rateick* '475 patent, and *Harada* (assuming these references may be combined, which Applicants do not admit) fails to establish *prima facie* obviousness of claim 7, which indirectly depends from claim 1. Furthermore, Applicants note that the Examiner's rejection of claim 7 is based on the

assertion that the TiN coating of *Harada* and the Borofuse coating of *Rateick, Jr.* are functional equivalents. Applicants disagree. Although both titanium nitride and boriding processes are means of hardening a wear surface to improve tribological performance, the processes differ significantly in the scale of affected material and the requirements for the basis metal or substrate. For boriding, using Haynes 25 as the basis metal for example, the case or hardened zone of the basis metal will be sufficiently thick (e.g., 25 microns thick) to sustain the mechanical load applied to the mating part, such that the basis metal does not require hardening prior to boriding. Titanium nitride, in contrast, is typically quite thin. For example, the physical vapour deposited (PVD) titanium nitride is nominally 2 microns thick. Thus, it is typically impractical to apply the titanium nitride coating to a basis metal that has not been sufficiently hardened. For at least this reason, Applicants do not agree with the Examiner's conclusion that a TiN coating and a Borofuse coating are equivalents. In view of the above, Applicants respectfully request reconsideration and withdrawal of the Examiner's rejection under 35 U.S.C. § 103 based on the asserted modification of *Beck* in view of "Cold Heading", the *Rateick* '475 patent, and *Harada*.

3. <u>*Rateick, Jr. - Davidson*</u>

Claims 19-22 stand rejected under 35 U.S.C. § 103 as allegedly being unpatentable over the *Rateick* '475 patent in view of *Davidson* (U.S. Patent 4,003,765). This rejection is respectfully traversed.

By way of review, independent claim 19 is directed to a method of forming and assembling a piston and wear resistant shoe, the shoe being formed from hardened rod

stock. The method of claim 19, as previously amended, comprises: machining a region of the hardened rod stock to form a cam engaging wear resistant surface of the wear resistant shoe; forming a hollow region in one rod stock end portion; annealing the one end portion of the rod stock; and crimping the periphery of the hollow region about a rounded end of the piston rod.

As described in the Background section of the present application, the *Rateick* '475 patent describes a technique for manufacturing a piston shoe 10 having a skirt/flange area 16 formed to the shape of a piston head 18, a wear surface 12 and back flange 14, which engage and wear on a cam plate 22 and auxiliary cam plate 24, respectively. In contrast to the method of claim 19, however, the technique disclosed in the *Rateick* '475 patent is not specific to forming and assembling a piston and wear resistant shoe using hardened rod stock as the starting material for forming the shoe. Thus, with reference to claim 19, the *Rateick* '475 patent does not machine a region of hardened rod stock to form a cam engaging wear resistant surface of the wear resistant shoe.

The secondary reference, *Davidson*, discloses a technique for heat treating cobalt based alloys. *Davidson* does not relate to a method of forming and assembling a piston and wear resistant shoe. In rejecting independent claim 19, the Examiner asserts on page 8 of the Office Action that:

> it would have been obvious to one of ordinary skill in the art to have utilized hardened material, such as that of Davidson, as the starting material, because it starts with an increased hardness (thus, providing more wear resistance) while maintaining sufficient ductility to be processed further.

For the *Rateick* '475 patent, however, the manufacturing process described therein is based on using a starting material with cold workability. *See e.g.*, col. 2, lines 14-17, stating

that "it is necessary for the piston shoe 10 to be corrosion resistant, compatible with aircraft fuel, provide the desired wear resistance, and provide the cold workability of a portion of the shoe." Thus, although Applicants do not dispute that a hardened starting material has increased hardness over a soft starting material, such a characteristic is deliberately avoided in the starting material for the processd of the *Rateick* '475 patent

At least inview of the above, Applicants respectfully request reconsideration and withdrawal of the Examiner's rejection under 35 U.S.C. § 103 based on the asserted combination of the *Rateick* '475 patent and *Davidson*.

Interview Request

If, despite the amendments and arguments presented herein, the Examiner maintains any of the prior art rejections, Applicants respectfully request the opportunity to conduct a personal interview in an effort to advance prosecution of this application. In such an event, the Examiner is respectfully requested to contact the undersigned to schedule an interview.

CONCLUSION

Should there be any outstanding matters that need to be resolved in the present application, the Examiner is respectfully requested to contact the undersigned at the telephone number below.

Applicants respectfully petition for a one (1) month extension of time pursuant to 37 C.F.R. §§ 1.17 and 1.136(a). A check in the amount of $110.00 in payment of the extension of time fee is attached.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17; particularly, extension of time fees.

Respectfully submitted,

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DRA/jdm
2929-0184P

Attachments: Version With Markings to Show Change Made
Partial English translation of *Beck* (DE 196 52 326)

Partial translation of:

DE 196 52 326

BECK, Josef et al.
Publication Date: 1997-12-11

Figure 1 shows a first embodiment of a produced forging (un-machined part) (1) of an intermediate product with the method according to the present invention. The forging (1) originates through forging a workpiece in the thickened linear guide engraved in the un-machined part contour (2). During a forging step, a recess (10) is preformed for receiving a ballhead that is flexibly attached to a sliding block (guide shoe) of a piston of an axial piston machine. In the area of the centerline (11), the recess (10) has a depression (12).

The inventive concept is that the crossing-point (forging cross) (6) is outside of the dashed-double-dotted line guide of the finished part contour (3). In comparison with the conventional method of the resultant formed forging (1) shown in Fig. 5, the crossing-point (6) is displaced, in the direction of the recess 10, on a side of an abutting face (13). The crossing-point (6) is located therewith outside of the functional area of the forging (1), in that the surrounding area of the finished part contour (3) is removed during a forging step following a post-processing step through removal of material. The post-processing step can be, for example, a rotary process or milling process. In the post-processing step a sliding block is formed in its final contour, so that the diameter of the finished recess (10') of the ball head conforms to a not shown piston of an axial piston

machine. Moreover, in the sliding block, in a known method, on a glide face (14) a pressure pocket (15) is formed, which is in contact with the finished recess (10') via a lubrication canal (16). In this way, hydraulic relief and lubrication of pressure fluid is attained into the pressure pocket (15) via a further canal in the piston.

The shifting of the crossing-point (6) is performed through displacement of the die partition plane, which, without anything, is made in a comparison of Fig. 1 and Fig. 5. The surrounding area of the crossing-point (6) with undefined textured fiber direction is removed, worked off, during the post-processing step of the manufacturing of the finished part (4).

Fig. 2 shows a second embodiment of a forging 1 formed through the forging step of the present invention. The mentioned elements and positions that are described below have similar descriptions so that a repetition of such is not necessary.

As is recognizable form Fig. 2, are two finished part contours 3.1 and 3.2 within the forged part contour 2 so that from the forged part (states 2, but should be 1 - MRG) two forged parts 4.1 and 4.2 are finished. By raising the yield, the efficiency of the inventive method is enhanced and the piece costs are noticeably reduced. Also in this embodiment, during the forging process, for every to be manufactured sliding block, a forge-recess 10.1 and 10.2 is formed already

during the forging process, which during the post processing step is worked into a finished recess 10.1' and 10.2'. For every finished part 4.1 and 4.2 forming a sliding block, is always a pressure pocket 15.1 and 15.2 provided on the sliding surface 14.1 and 14.2, which is always connected with the finished recess 10.1' and 10.2' via a lubrication canal 16.1 and 16.2.

Also in the embodiment shown in Fig. 2, the crossing point (6) is located outside of both of the finished part contours 3.1 and 3.2. In the portrayed embodiment, the crossing point (6) is located in the area in which the axial symmetrical axis forms a lengthwise axis (11) between the two finished part contours 3.1 and 3.2. This is achieved in that the die partition plane (7) is placed in the middle of the forging 1, in between both of the finished part contours 3.1 and 3.2. Also in this embodiment, undefined textured fiber direction is thereby in the area of the crossing point (6), outside the finished part contours 3.1 and 3.2 and thereby outside of the functional area.

Fig. 3 and Fig. 4 each show a third and fourth embodiment of a forging 1, which is manufactured with the forging step of the inventive method.

The process shown in Fig. 3 and Fig. 4 is common in that two finished parts 4.1 and 4.2 are produced from one forging 1. The crossing point 6 is located outside of both of the finished part contours 3.1 and 3.2 and between both of the finished parts 4.1 and 4.2. The area surrounding the crossing point 6 with an undefined

textured fiber direction is worked off, removed, in the post-processing step. Further, common to the embodiments shown in Fig. 3 and Fig. 4, is that the finished recesses 10.1' and 10.2' are completely formed during the post processing step and that there are no formed recesses during the forging step as in the above described examples. Therewith, the forging process is simplified and further processing costs can be saved.

The example shown in Fig. 3 and Fig. 4 is further common, in that finished part contours 3.1 and 3.2 are positioned mirror-symetrical to one another within the forging part contour 2. The examples are different in that , in the example shown in Fig. 3, the sliding surfaces 4.1 and 4.2 are faced adjacent to each other, while the example shown in Fig. 4, the finished recesses 10.1' and 10.2' are faced adjacent to each other. Pertinent is a spread 17 foreseen in the forged part contour 2 in the example of Fig. 3, whereas in the example shown in Fig. 4, spreads 17.1 and 17.2 are arranged on peripheral ends. In the examples in Fig. 3 and Fig. 4, the partition plane 7 is arranged so that it imbeds the axial length axis 11.

The above-described invention is not limited to the shown examples, for example, it is thinkable that, not only two, but also several finished parts 4 can be formed from the forging 1. The finished contour 2 does not necessarily have to have the spreads 17 or 17.1 and 17.2; it is foreseeable that the forging can be formed in a cylinder shape.

So long as during the forging step, not only one, but several crossing points 6 result, is therefore to consider that several crossing points 6 are found outside of the finished part contours 3, and 3.1 and 3.2.

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS:

The claims have been amended as follows:

1. (Twice Amended) A method of manufacturing a wear resistant shoe, comprising:

cold-heading one end portion of a generally cylindrical blank to radially increase and axially diminish the dimensions of the one end portion, and to work harden the one end portion while leaving an opposite end portion dimensionally unchanged <u>and maintaining cold-workability of the opposite end portion</u>;

machining the previously cold-headed one end portion to form a cam engaging portion of said wear resistant shoe; and

subsequently cold-working and thereby hardening the opposite end portion.

10. (Twice Amended) A method of manufacturing a wear resistant shoe, comprising:

work hardening a portion of a cylindrical member to a substantial depth <u>while leaving another portion of the cylindrical member dimensionally unchanged and maintaining cold-workability of said another portion</u>;

machining the work-hardened cylindrical member portion to finished dimensions, thereby forming a cam engaging portion of said wear resistant shoe; and

surface hardening a face of the machined cylindrical member portion.

11. (Amended) The method of claim 10, including the additional step of machining said another portion of the cylindrical member to form a hollow skirt in said another portion for receiving a rounded end of a piston rod.

15. (Twice Amended) A method of forming and assembling a piston and wear resistant shoe, the shoe formed from rod stock of a diameter less than the greatest diameter of the finished shoe, comprising:

upsetting one end portion of the rod stock to axially reduce and radially increase the dimensions of the one end portion, and to work harden the one end portion while leaving an opposite end portion dimensionally unchanged and maintaining cold-workability of the opposite end portion;

machining the previously upset one end portion to form a cam engaging portion of said wear resistant shoe;

forming a hollow region in an opposite rod stock end portion; and

crimping the periphery of the hollow region about a rounded end of the piston rod.